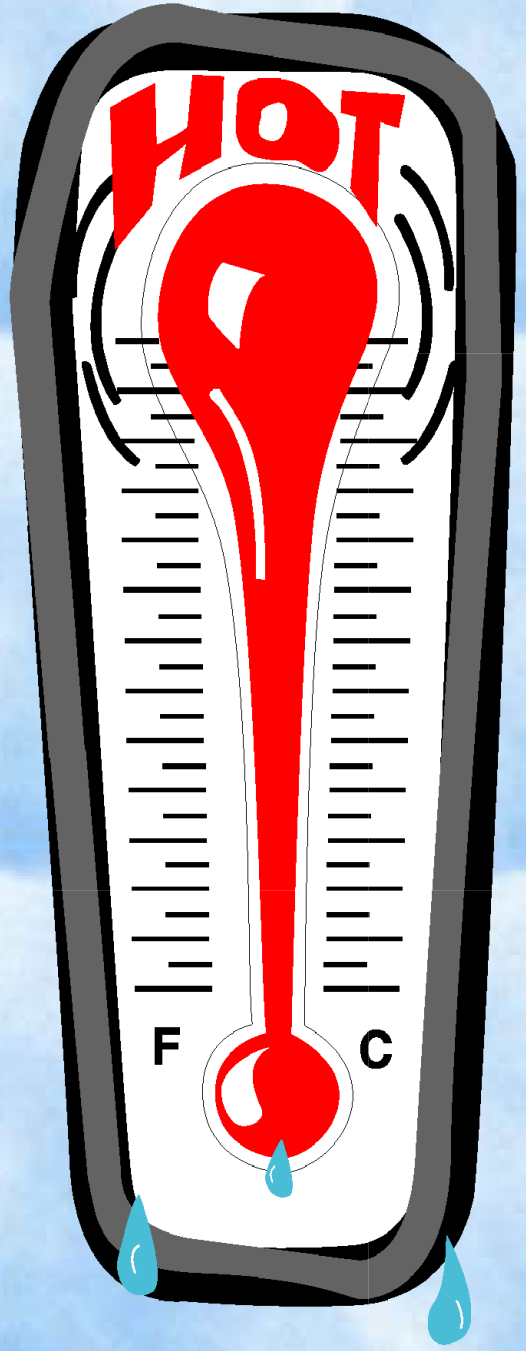
CLIMATE CHANGE AND ENERGY USE IN TODAY'S WORLD



CHILLING CONSIDERATIONS REGARDING GLOBAL WARMING

Stephen E. Schwartz

BROOKHAVEN
NATIONAL LABORATORY

summer sundays

www.ecd.bnl.gov/steve

SPEAKER

Stephen E. Schwartz, Ph.D.

BROOKHAVEN NATIONAL LABORATORY

About the speaker

A Senior Scientist in the Atmospheric Sciences Division, atmospheric chemist Stephen E. Schwartz, Ph.D., is well recognized in his field for his innovative research quantifying the chemistry and physics of clouds and aerosols, and for his leadership of national atmospheric research programs.

By researching the reactions taking place within and among clouds, Dr. Schwartz studies how cloud chemistry and physics influence the Earth's climate — and climate change.

After earning his A.B. from Harvard University in 1963, Stephen E. Schwartz took his Ph.D. in 1968 from the University of California, Berkeley. Following Woodrow Wilson and National Science Foundation fellowships, he served as a Fulbright post-doctoral Fellow at the University of Cambridge, England, 1968-69.

Having taught at the State University of New York at Stony Brook, 1969-75, Dr. Schwartz joined the Lab as an Associate Scientist. Moving up the ranks, he was named Scientist in 1977 and to his present position in 1990.

Dr. Schwartz is a Fellow of the American Association for the Advancement of Science and the American Geophysical Union. He was honored with the Lab's Science and Technology Award in 2006.

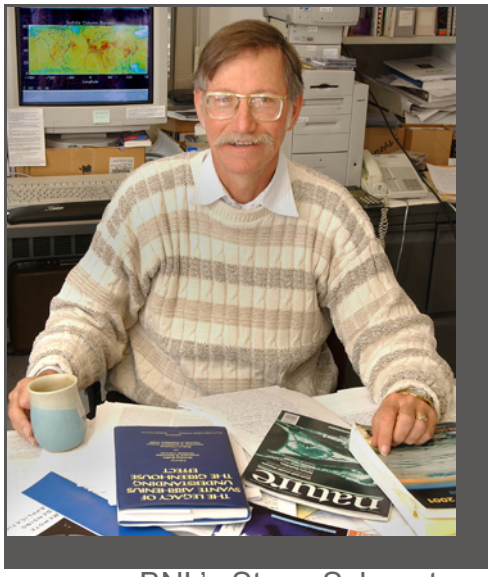
A view of Brookhaven National Lab

Climate Change and Energy Use in Today's World

Some Chilling Considerations About Global Warming

by Stephen E. Schwartz, Ph.D., Brookhaven National Laboratory

We heat, cool and light our homes; grow our food, and manufacture goods; and move these items and people around using coal, oil or natural gas — also known as fossil fuels.



BNL's Steve Schwartz

Fossil fuels are miracle substances: They have a high energy density per mass and volume, and, moreover, they are provided free by nature. Since the Industrial Revolution until more recently, we thought the only costs associated with fossil fuels were those for extracting, refining, storing, distributing, and using them.

But, as the scientifically established link between global climate change and fossil fuel use has shown us, as well as such events as the recent leak of the BP oil well in the Gulf of Mexico, humankind is paying a bigger price for using fossil fuels — and it is a cost that atmospheric chemist Stephen E. Schwartz will discuss in his talk, from scientific, societal and individual points of view.

Dr. Schwartz will begin by explaining how the atmospheric concentration of greenhouse gases, particularly carbon dioxide, is increased when fossil fuels are burned to extract energy. Since the Industrial Revolution, we have increased the concentration of carbon dioxide in Earth's atmosphere by some 35 percent over its pre-Industrial Revolution value — and that is having an impact on global temperature and weather.

If we continue to increase atmospheric carbon dioxide, then what will the Earth be like for future generations? According to Dr. Schwartz, this question cannot be answered precisely at this time because of our imperfect scientific understanding of the situation. If we do nothing to curb the increase, however, then potential consequences range from the serious to the catastrophic.

For a copy of Dr. Schwartz's presentation, go to the Web page www.ecd.bnl.gov/steve/pop/SummerSunday2010.pdf.

About Brookhaven National Laboratory

Established in 1947 on an almost 5,300-acre, $3.2-billion campus in the center of Long Island, Brookhaven Lab is an internationally renowned scientific research institution owned by the U.S. Department of Energy's Office of Science, which provides most of the Lab's approximately $500-million annual budget.

Brookhaven National Laboratory conducts research in the physical, biomedical, and environmental sciences, as well as in energy technologies and national and homeland security. Brookhaven Lab also builds and operates major scientific facilities available to university, industry and government researchers.

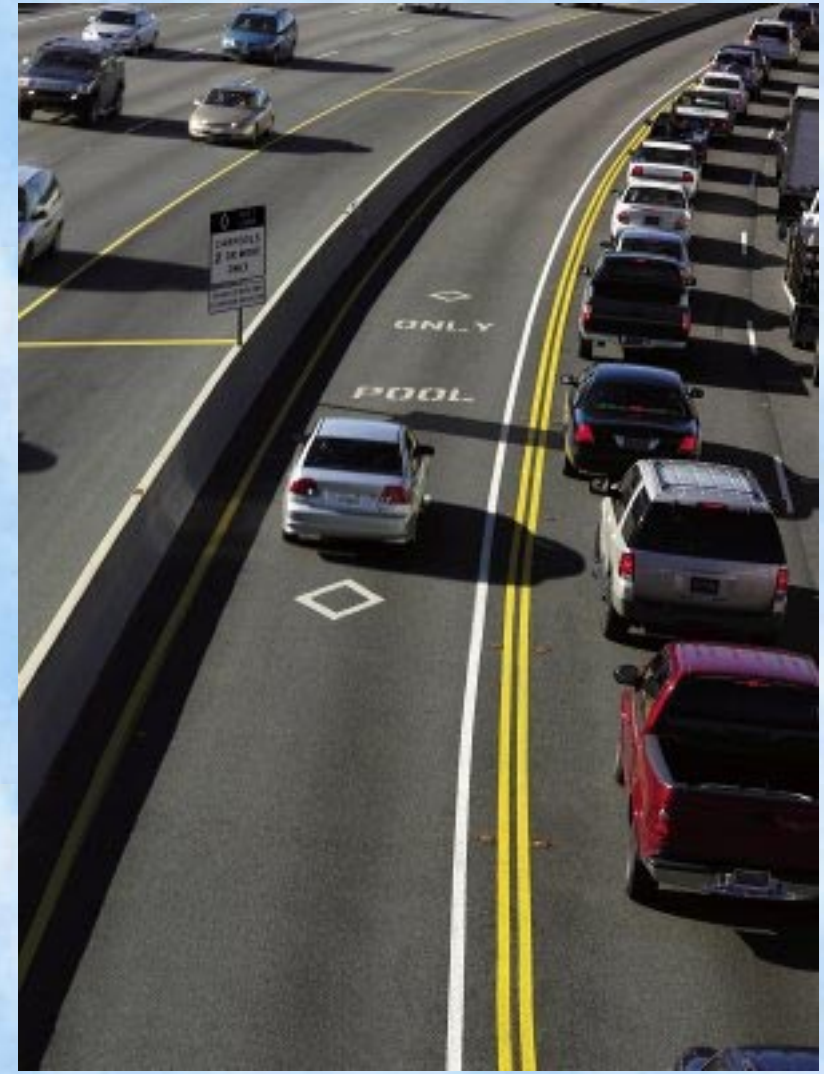
The only national laboratory in the Northeast U.S., Brookhaven Lab is operated and managed for DOE's Office of Science by Brookhaven Science Associates, a limited-liability company founded by Long Island's Stony Brook University, which is the largest academic user of Laboratory facilities, and Battelle, which is a non-profit, applied science and technology organization headquartered in Ohio.

2010

THE MOST EFFECTIVE WAY TO DOUBLE THE FUEL ECONOMY OF A CAR . . .

IS TO PUT TWO PEOPLE IN IT!

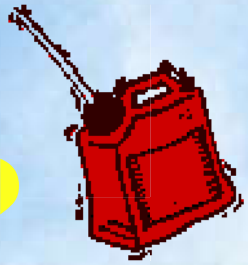
CARPOOLING CAN SAVE MORE THAN GAS



HOW MUCH CARBON IS IN A GALLON OF GASOLINE?

1 lb?

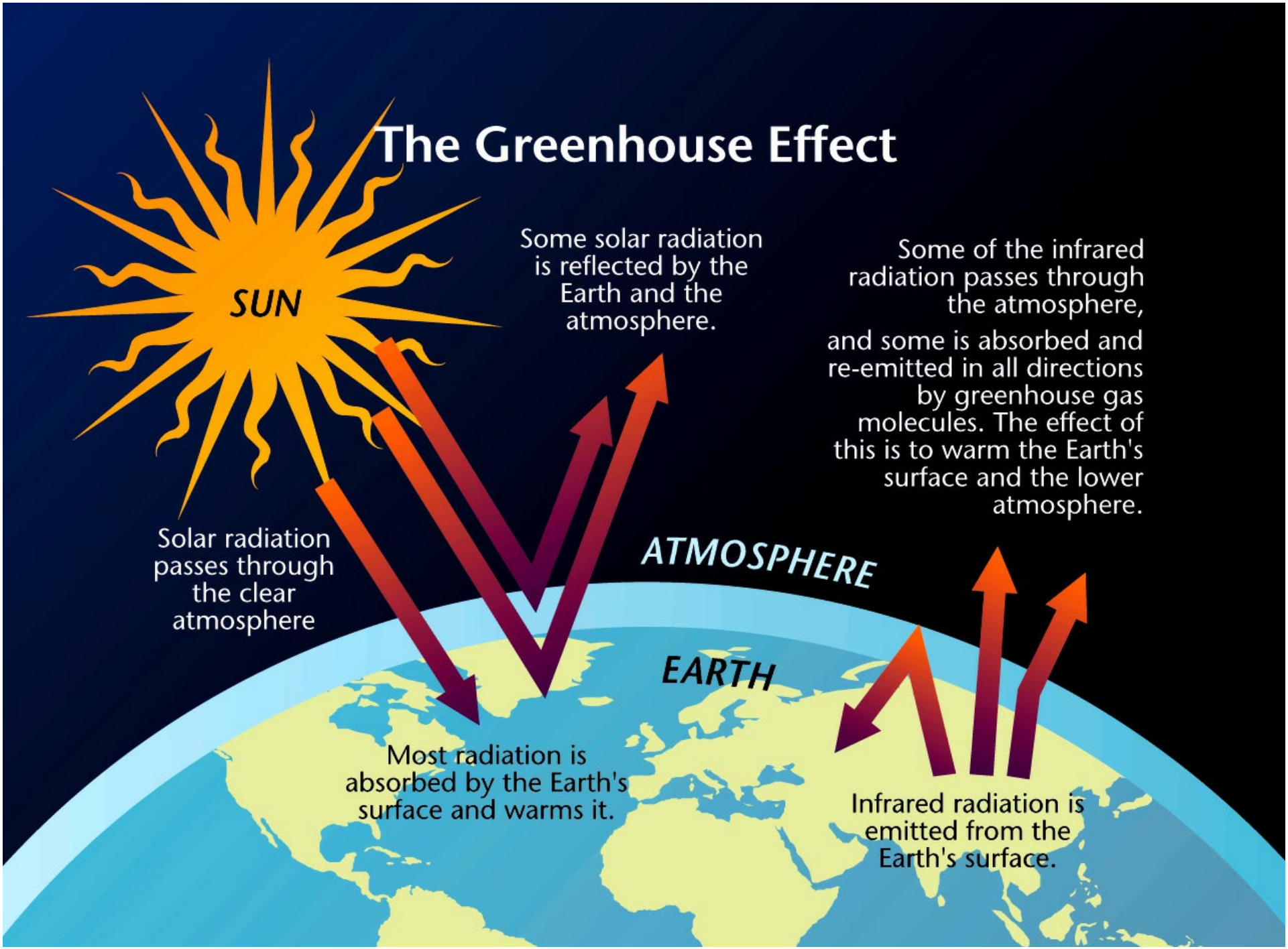
2 lbs?



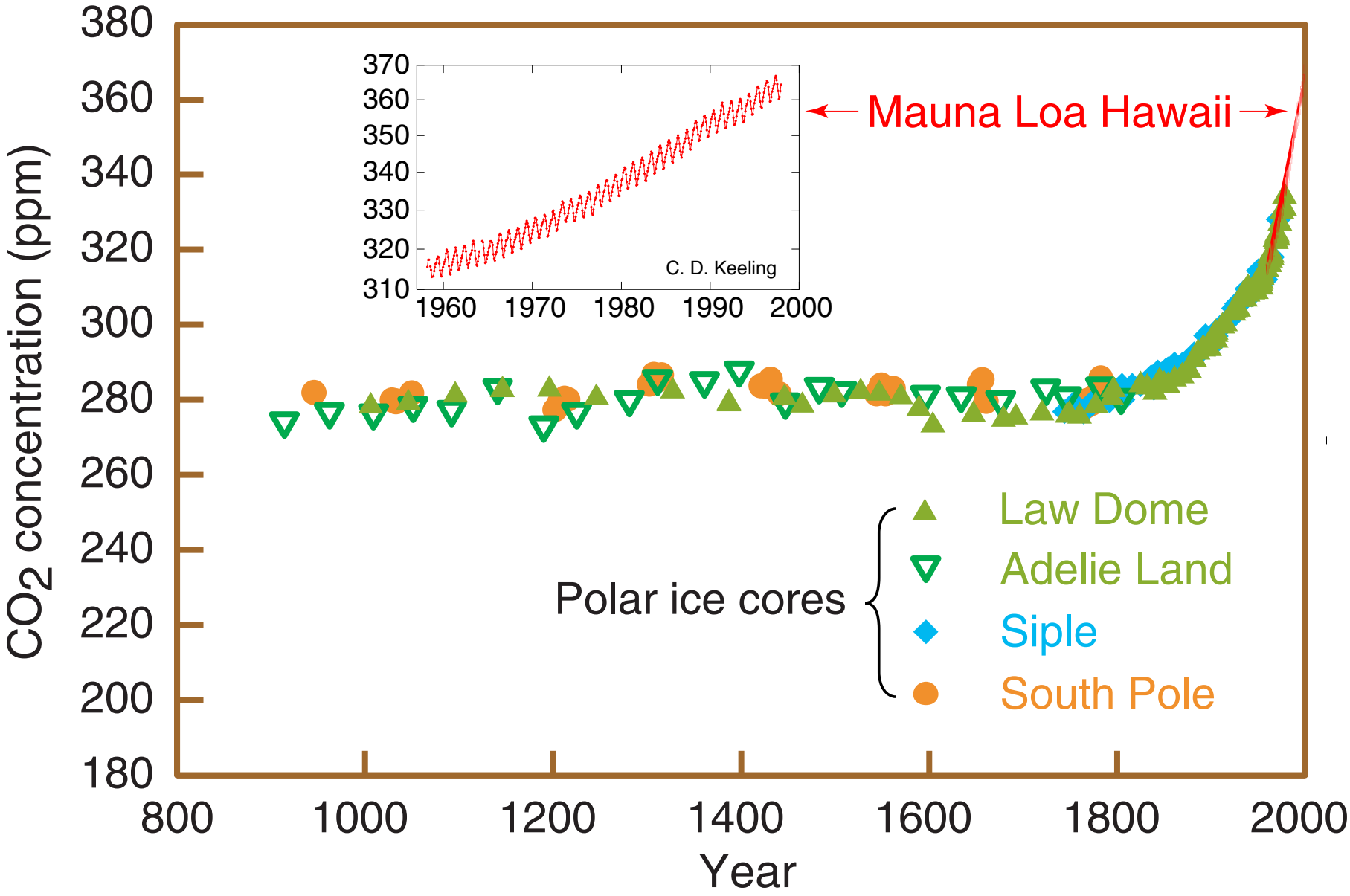
3 lbs!?

5 lbs!?!

All of this carbon goes into the atmosphere as carbon dioxide when you burn the gasoline in your car.

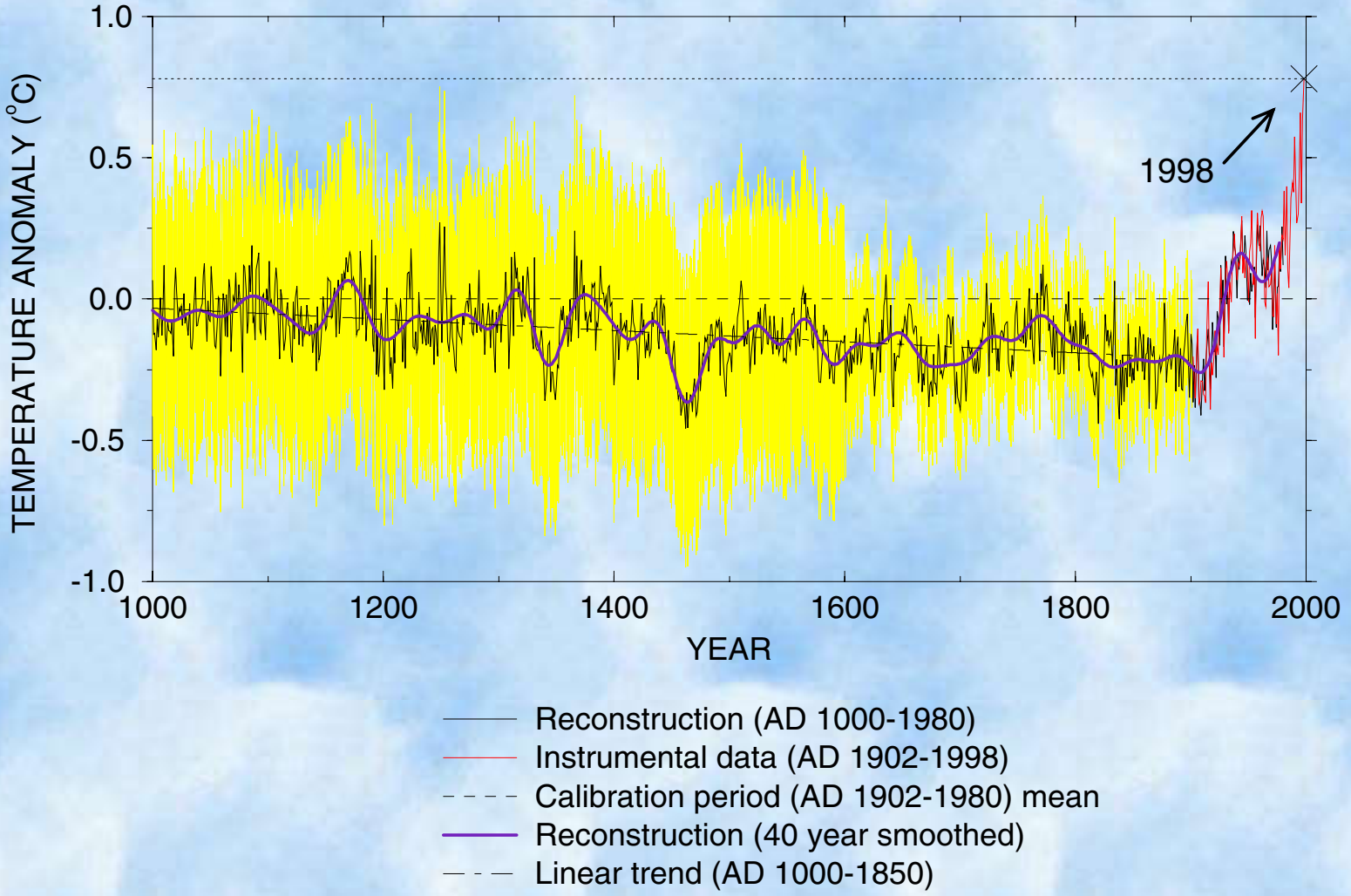

The Greenhouse Effect
SUN
Some solar radiation is reflected by the Earth and the atmosphere.
Some of the infrared radiation passes through the atmosphere,
and some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the Earth's surface and the lower atmosphere.
Solar radiation passes through the clear atmosphere
ATMOSPHERE
EARTH
Most radiation is absorbed by the Earth's surface and warms it.
Infrared radiation is emitted from the Earth's surface.

ATMOSPHERIC CARBON DIOXIDE IS INCREASING



Global carbon dioxide concentration over the last thousand years

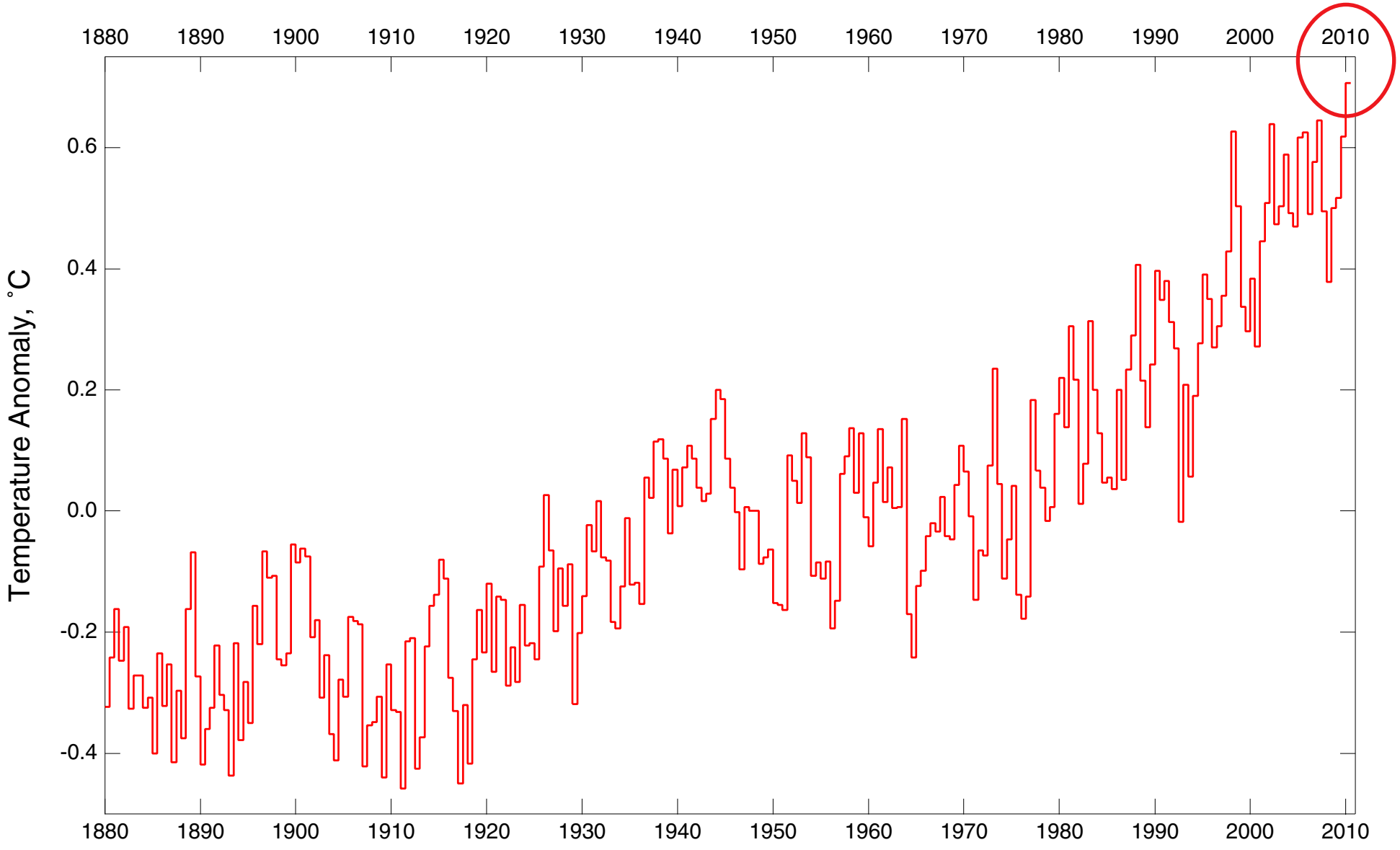
THE TEMPERATURE'S RISING



Northern Hemisphere temperature trend (1000-1998), from tree-ring, coral, and ice-core proxy records As calibrated by instrumental measurements.

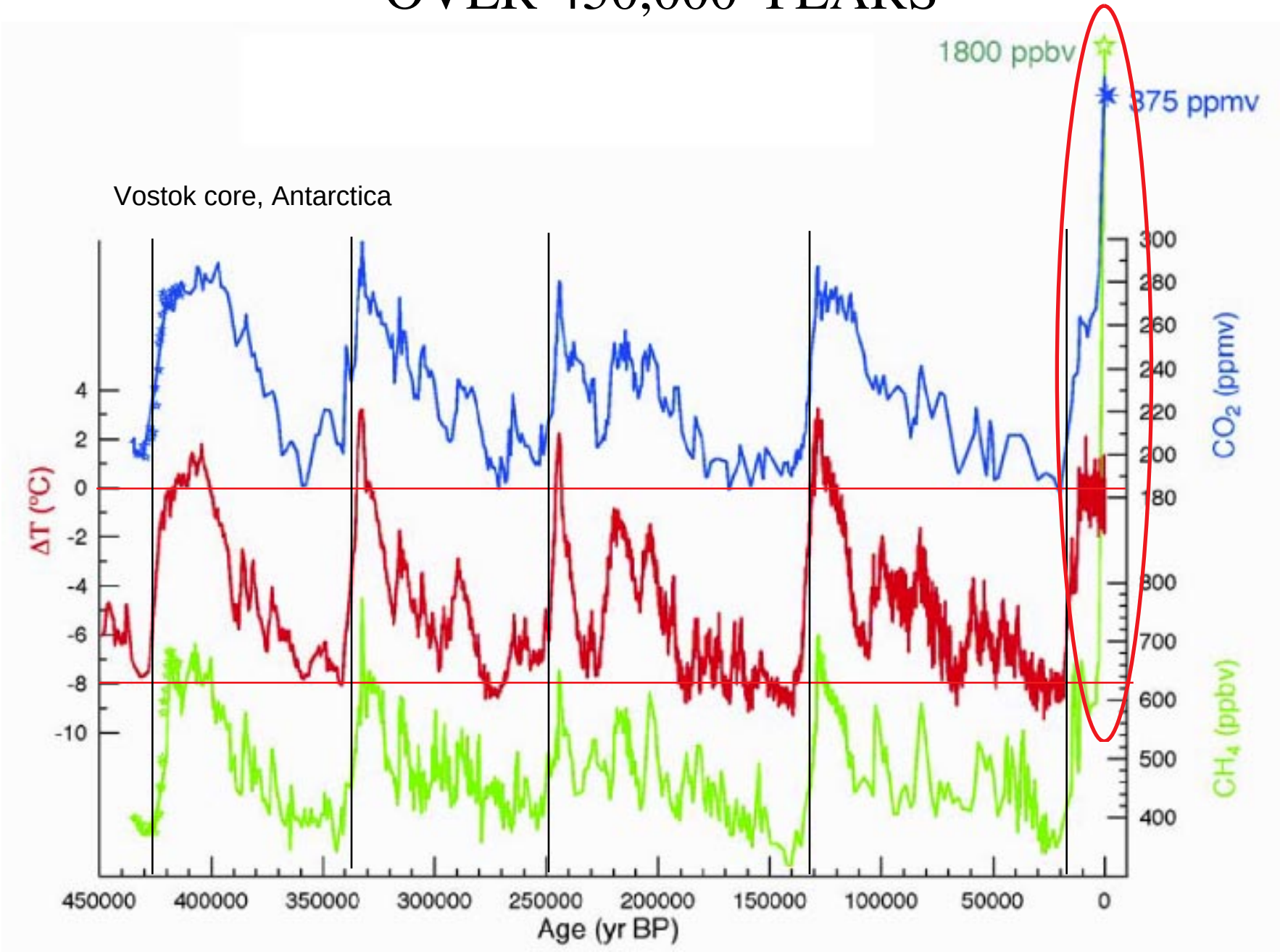
Mann et al., Geophysical Research Letters, 1999

GLOBAL SEMI-ANNUAL TEMPERATURE ANOMALY, 1880-2010



Data: Goddard Institute for Space Studies

GREENHOUSE GASES AND TEMPERATURE OVER 450,000 YEARS



Modified from Petit et al., Nature, 1999

2009 COPENHAGEN ACCORD ENDORSES 2°C (3.6 °F) MAXIMUM TEPERATURE RISE

The Heads of State, Heads of Government, Ministers, and other heads of the following delegations present at the United Nations Climate Change Conference 2009 in Copenhagen:[1]
Albania, Algeria, Armenia, Australia, Austria, Bahamas, Bangladesh, Belarus, Belgium, Benin, Bhutan,

▪ ▪ ▪

Tonga, Trinidad and Tobago, Tunisia, United Arab Emirates, United Kingdom of Great Britain and Northern Ireland, United Republic of Tanzania, United States of America, Uruguay and Zambia,

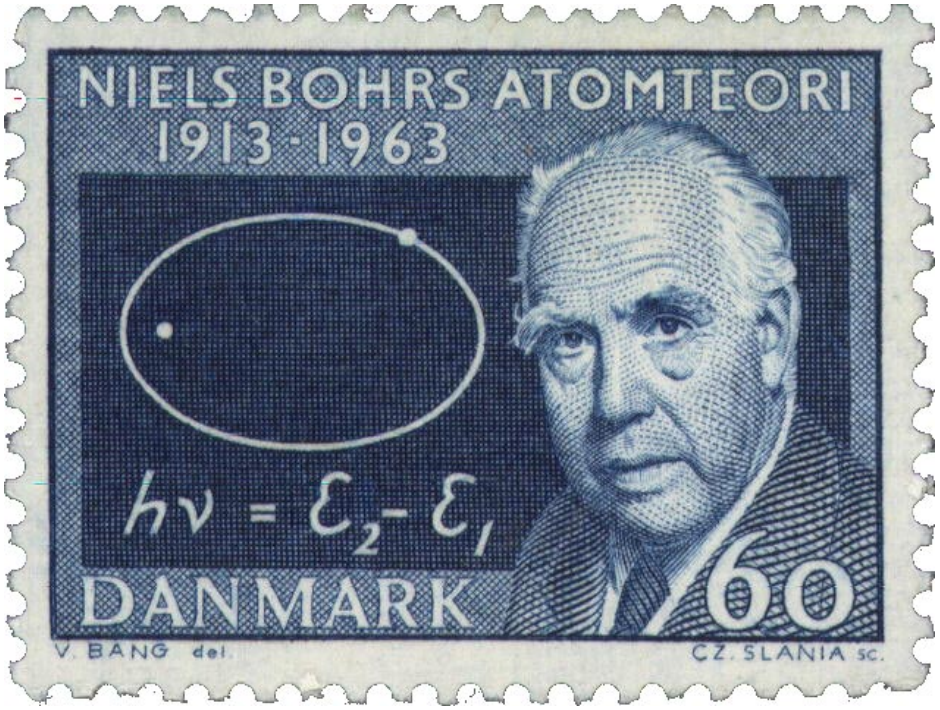
▪ ▪ ▪

Have agreed on this Copenhagen Accord which is operational immediately.

1. We underline that climate change is one of the greatest challenges of our time. We emphasise our strong political will to urgently combat climate change in accordance with the principle of common but differentiated responsibilities and respective capabilities. To achieve the ultimate objective of the Convention to stabilize greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system, we shall, recognizing the scientific view that the increase in global temperature should be below 2 degrees Celsius, on the basis of equity and in the context of sustainable development, enhance our long-term cooperative action to combat climate change. We recognize the critical impacts of climate change and the potential impacts of response measures on countries particularly vulnerable to its adverse effects and stress the need to establish a comprehensive adaptation programme including international support.

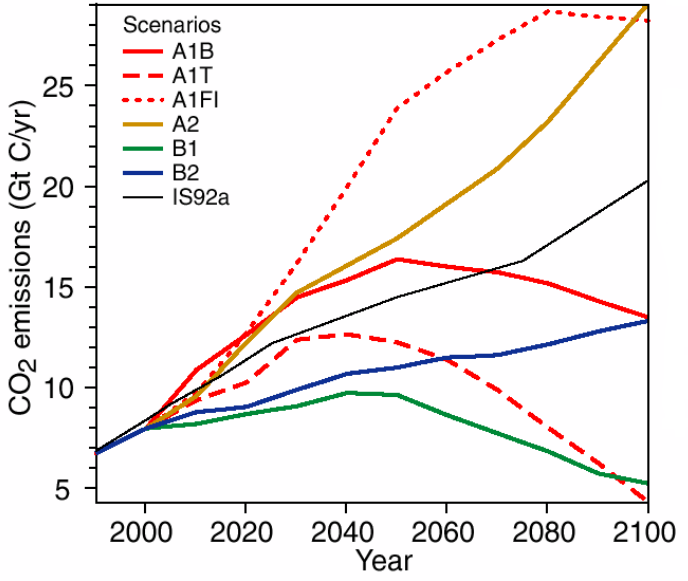
Looking to the Future . . .

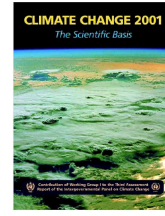
Prediction is difficult,
especially about the future.



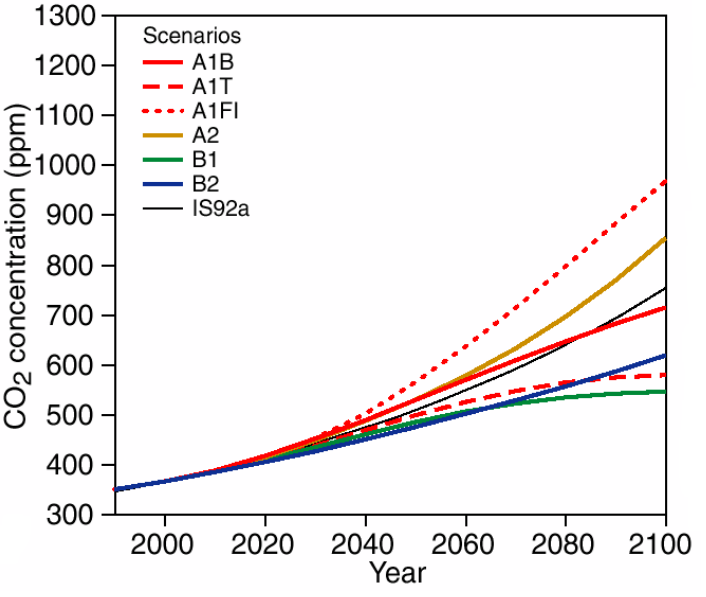
– Niels Bohr

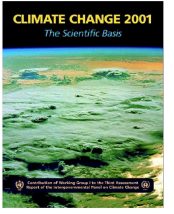
PROJECTIONS OF FUTURE CO2 EMISSIONS



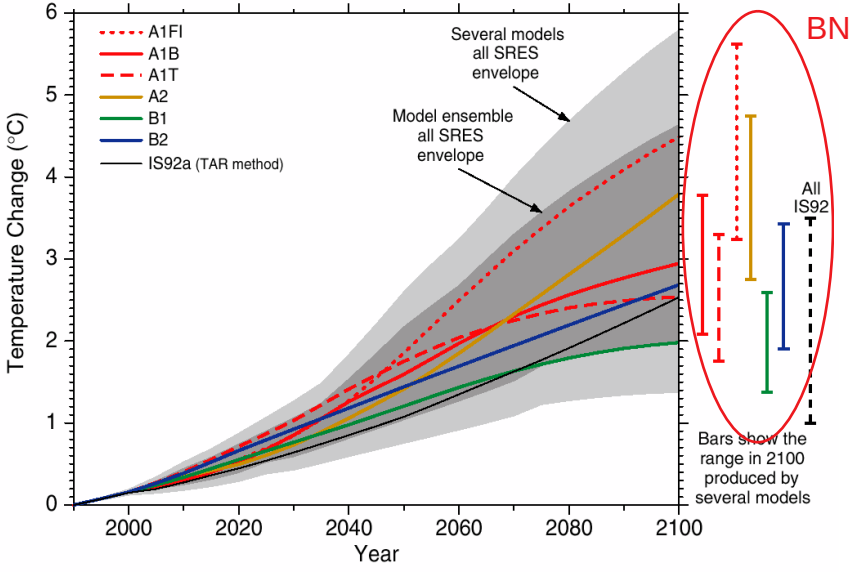


PROJECTIONS OF FUTURE CO2 CONCENTRATIONS

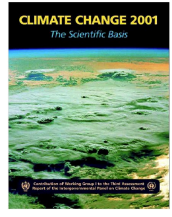




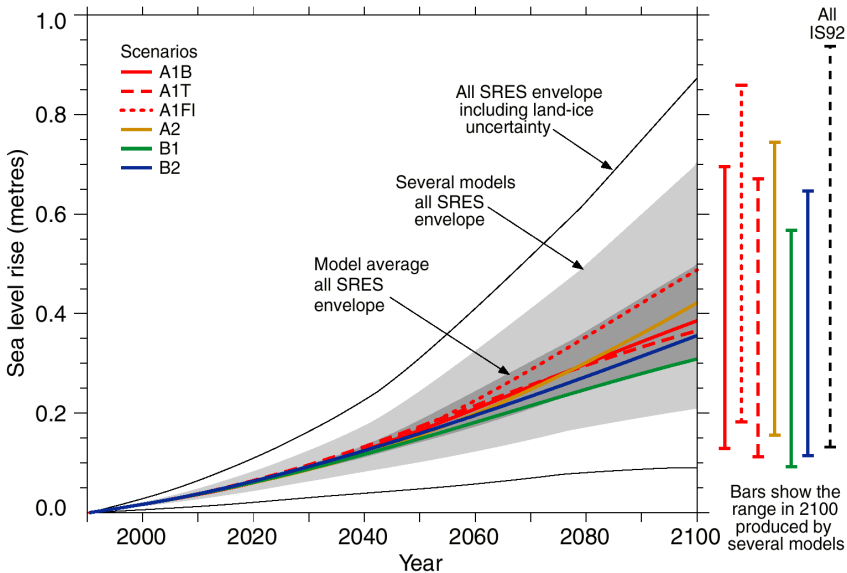
PROJECTIONS OF FUTURE TEMPERATURE CHANGE

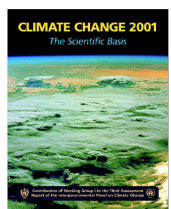


BNL Research



PROJECTIONS OF FUTURE SEA LEVEL RISE

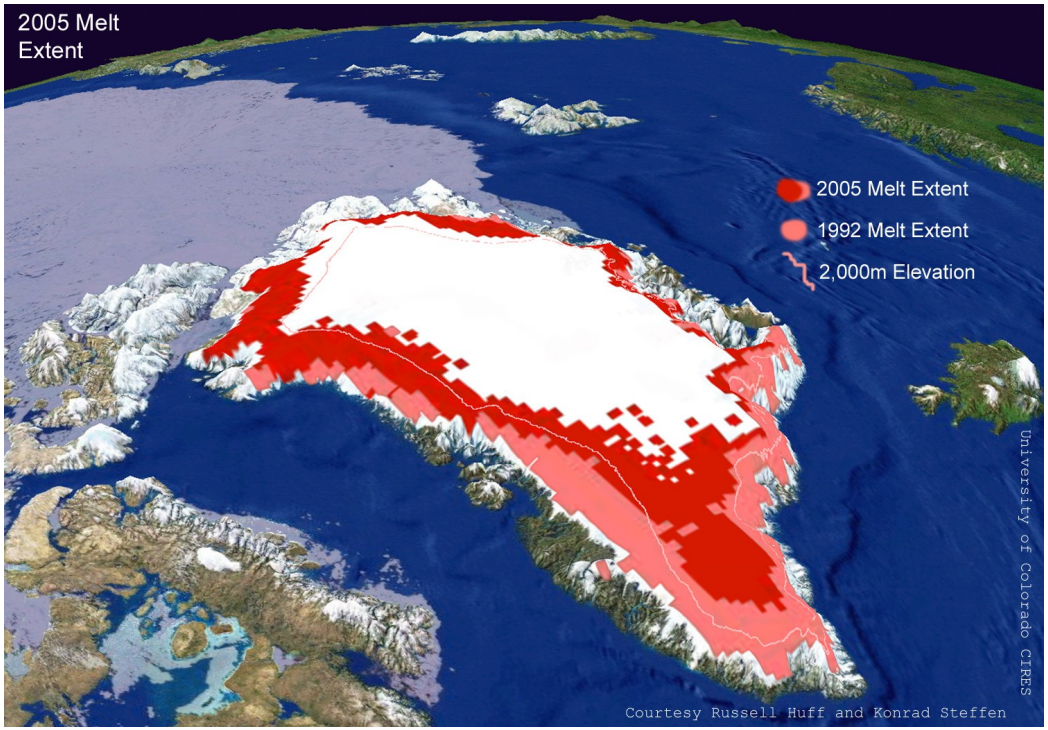




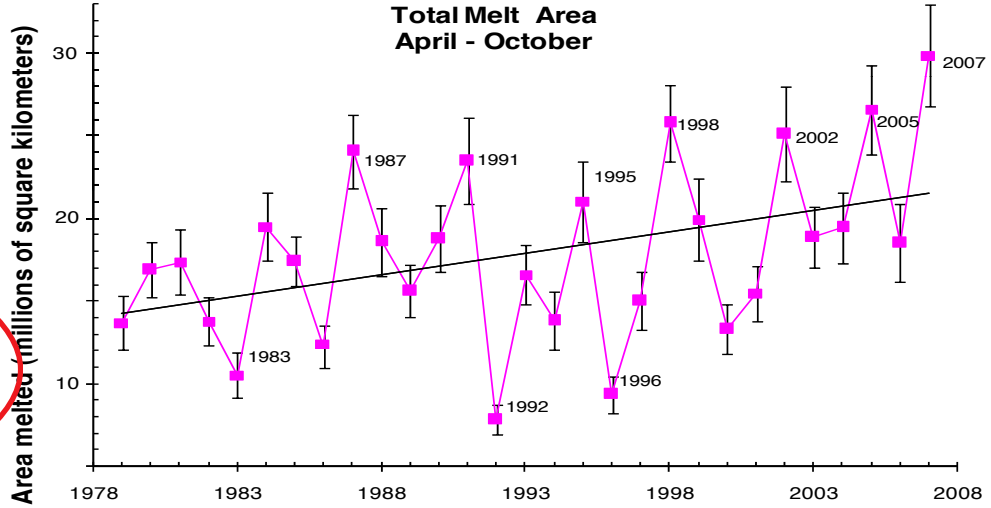
MELTING OF GREENLAND ICE CAP

Satellite determination of maximum extent of glacial melt

NASA



Complete melt of the Greenland ice sheet would raise the level of the global ocean 23 feet.

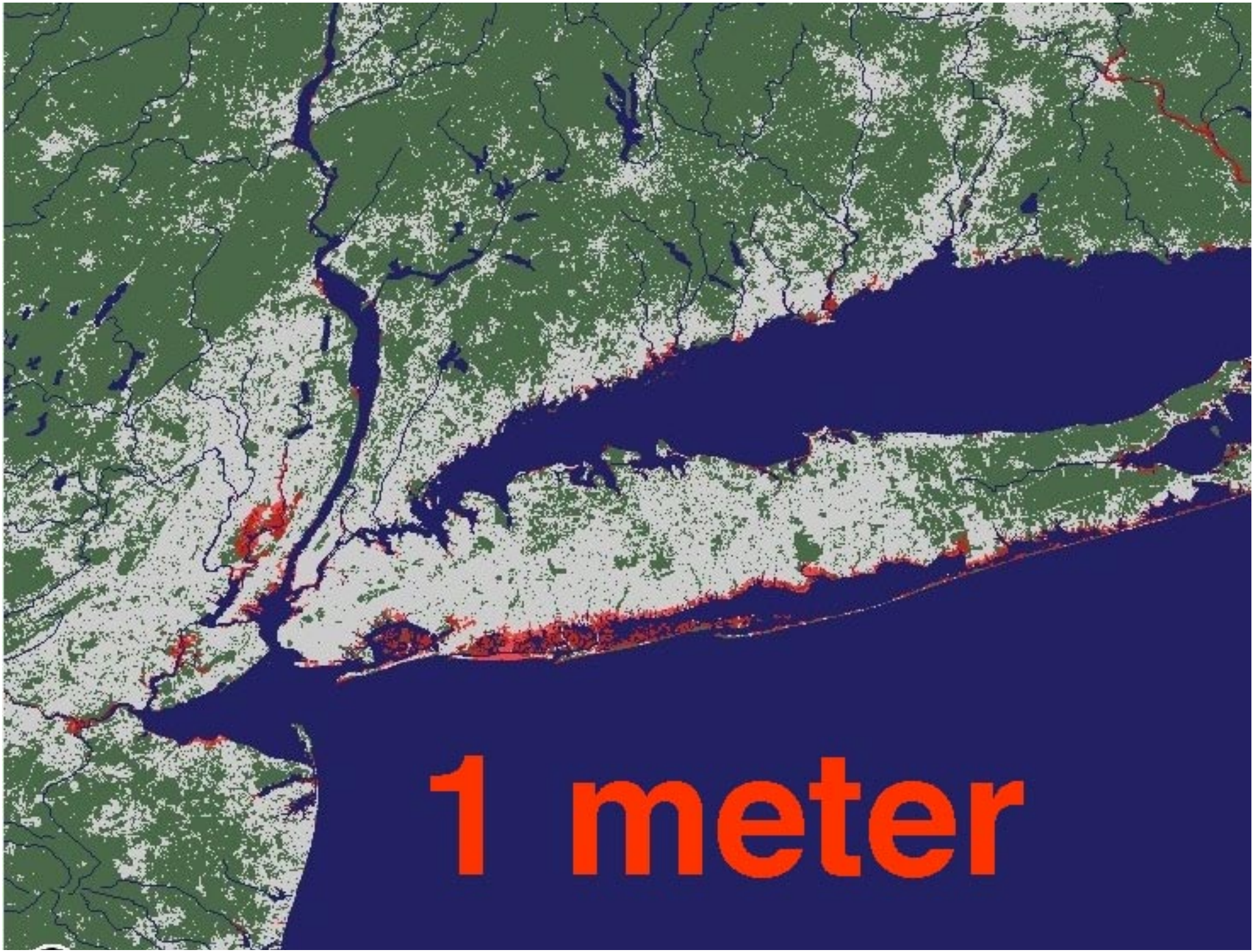


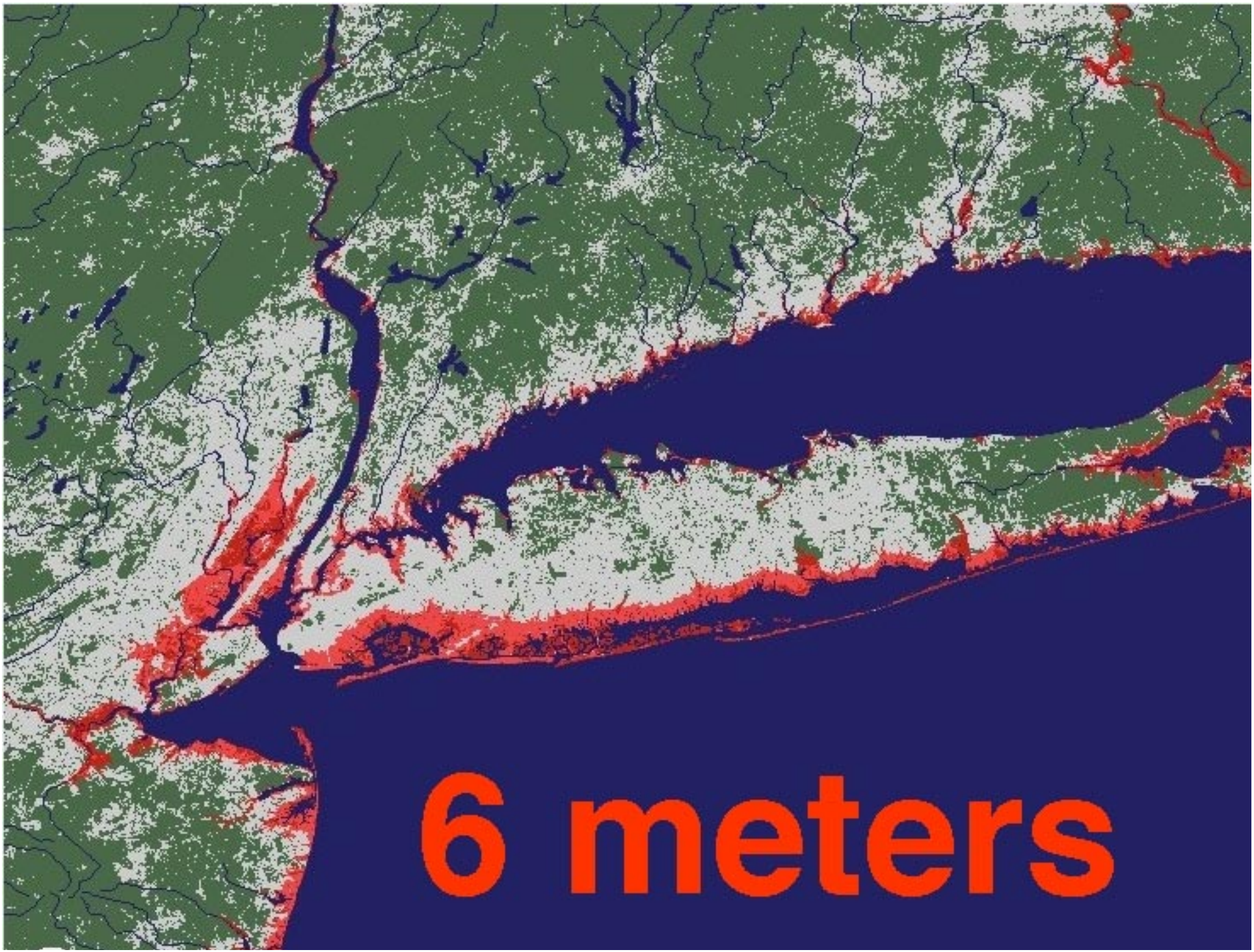
Steffen & Huff , Univ. Colo., 2005

THE BIG PROBLEM FOR LONG ISLAND . . .

RISING SEA LEVEL


present


1 meter


6 meters


NEW YORK
Albany
MASSACHUSETTS
Boston
Springfield
Hartford
Providence
Cape Cod
PENNSYLVANIA
CONNECTICUT
RHODE ISLAND
Newark
Philadelphia
New York City
Wilmington
Trenton
MARYLAND
Camden
NEW JERSEY
Atlantic Ocean
Baltimore
DELAWARE
WASHINGTON DC
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Richmond
Hampton
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Norfolk
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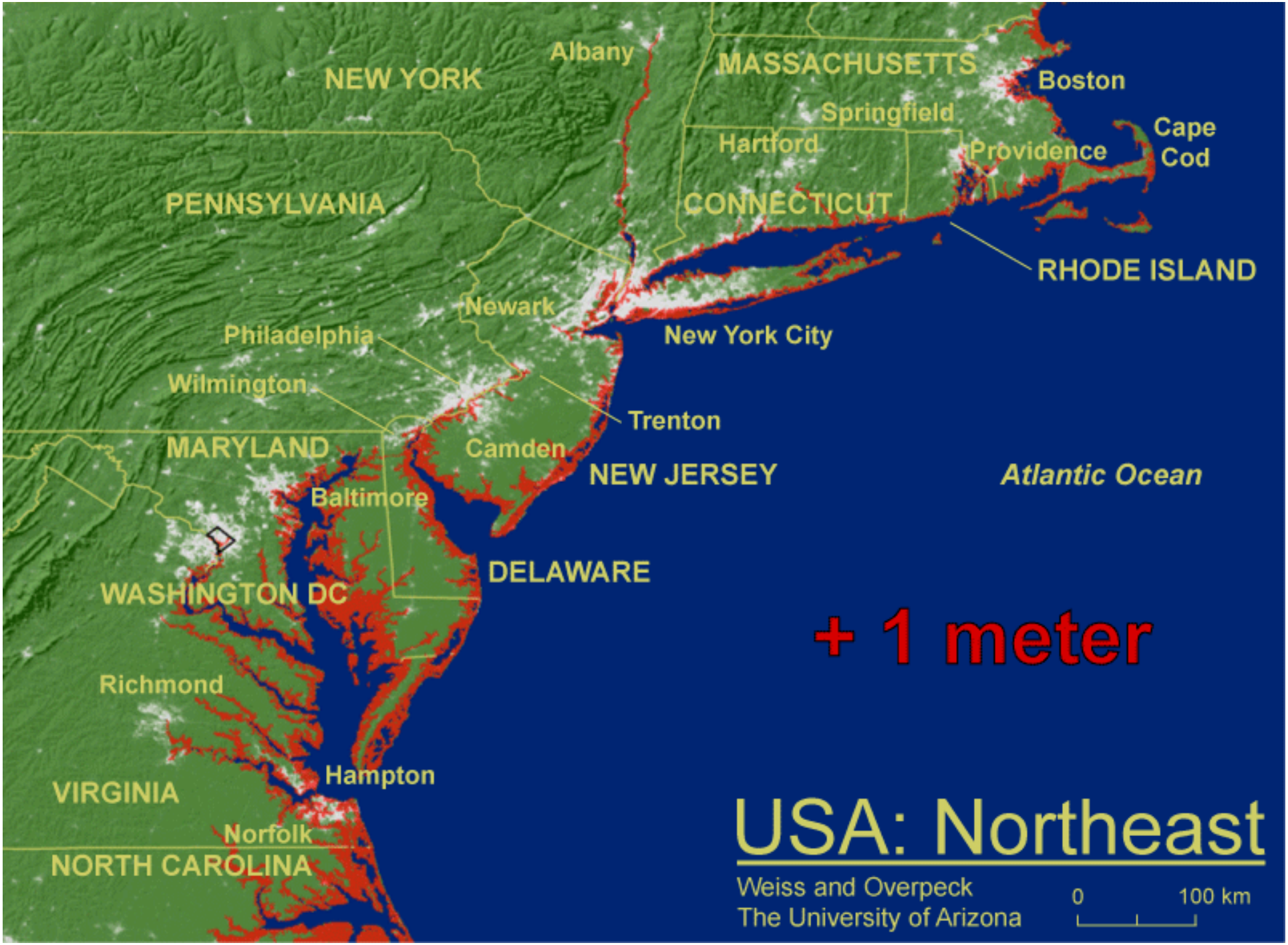
USA: Northeast
Weiss and Overpeck
The University of Arizona
0
100 km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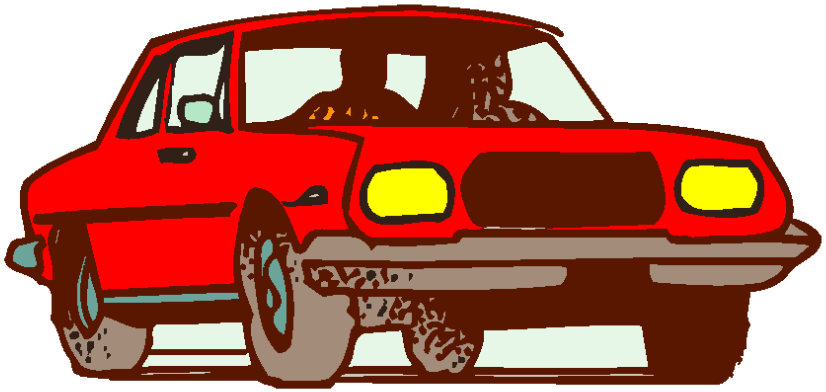
MARYLAND
Camden
NEW JERSEY
Atlantic Ocean
Baltimore
DELAWARE
WASHINGTON DC
+ 1 meter
Richmond
Hampton
VIRGINIA
Norfolk
NORTH CAROLINA
USA: Northeast
Weiss and Overpeck
The University of Arizona
0
100 km

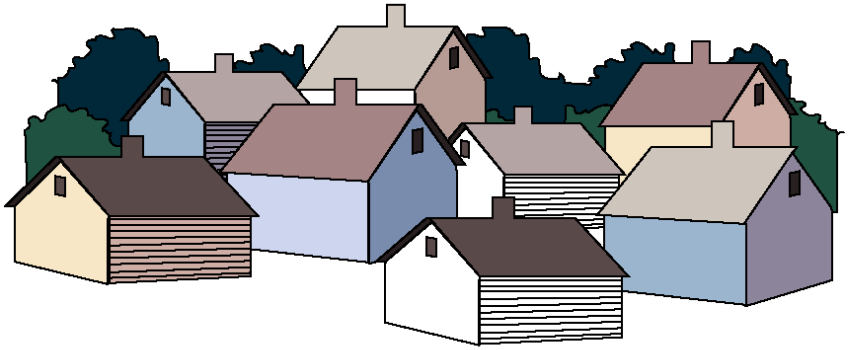
WHERE IS THIS CARBON DIOXIDE COMING FROM?

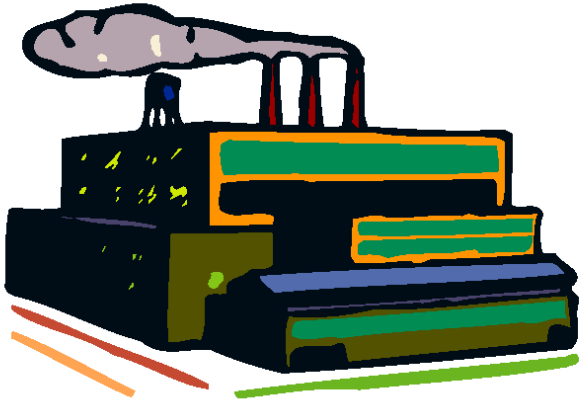
WE ARE ALL RESPONSIBLE.



Burning a gallon of gasoline in your car puts 5 pounds of carbon in the atmosphere as carbon dioxide (CO_2), and it will stay there for decades — maybe a century!

Other sources are home heating and electric power production.





Global Atmosphere, Global Warming

QUESTIONS ABOUT GLOBAL WARMING

- IS IT REAL?
- IS IT IMPORTANT?
- WHAT IS IT DUE TO?
- HOW MUCH MORE CAN WE EXPECT?
- ARE WE SEEING JUST THE TIP OF THE ICEBERG?

RESEARCH IS HELPING TO ANSWER THESE QUESTIONS.

www.ecd.bnl.gov/steve

THANK YOU

BROOKHAVEN
NATIONAL LABORATORY

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